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ABSTRACT

By the year 2000, European higher education institutions must achieve the following aims: resolve the conflict between the social demand for education and costs of higher education without lowering standards; provide continuing education to cope with rapid technological change and increased leisure and/or unemployment; build even closer links between industry, public services, and higher education in the field of informatics; and infuse new talent into static academic manpower. Informatics (varied new communications technologies that are based around microprocessing and optics) may enable the achievement of those aims. The move to distance education and independent learning will accelerate through computer conferencing, cable television and videocassettes, computer-based audiographic systems, and interactive videodiscs. New technologies offer an alternative model to the large, centralized specialist system, because they are both easy to access and easy for teachers to use. The technology needed to achieve these aims is here now, and will become increasingly easier to use. The main barrier is the inability of large institutions to carry through the fundamental changes in organization, financial arrangements, and teaching strategies that are essential if flexible, off-campus teaching is to be achieved. Eight references are listed. (LMM)

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The Implications for Teaching and Learning of New Informatics Developments

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FOUR AIMS

I take as my starting point four requirements for European higher education between now and the year 2000, already well-defined in other papers prepared for this conference:[1]

1. the need to resolve the conflict between 'social demand' and 'expenditure driven' approaches to higher education, if mass higher education in Europe is to be achieved: catering for more students with less money, without lowering standards;

2. the need for 'éducation permanente', both to cope with rapid technological change and increased leisure and/or unemployment;

3. the need for even closer links between industry, public services, and higher education, especially in the field of information technology, if for no other reason than to justify continued public support for this sector of education;

4. the need to infuse new new talent into what is becoming a very static academic manpower.

The question then is:

Can informatics enable these aims to be achieved through their contribution to teaching and learning?

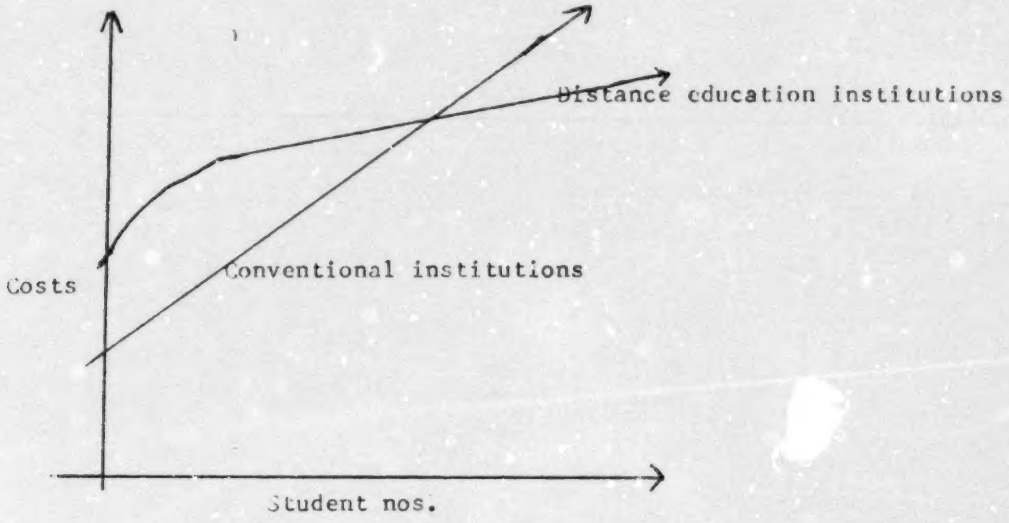
WHAT ARE INFORMATICS?

I believe that there is an outside chance that they can. Indeed, without the use of new information technology, I think there is little chance of the four aims being achieved.

Well, what are informatics? I will leave it to the Academie Française to worry about whether it's good French, but it's certainly rotten English. I therefore intend from this point to abandon the term, and talk about new communications technologies, because that is what it's all about. We are talking about a range of technologies based around microprocessing and optics. Note that "computing" is a misleading term in this context, since it is only one of a range of functions that can be handled by these technologies.

New communications technologies will accelerate the move to distance education, and independent learning, and it is through this route that the best chances lie of meeting the four aims. Indeed, whereas distance education is now seen as rather a fringe activity in higher education, I believe that it is inevitable that it will become the main means by which teaching at a higher education level is carried out, if not by the year 2000 then soon afterwards. There are several reasons for this inevitability:

1. Distance education can handle greater numbers of higher education students more cost-effectively than conventional higher education. The cost structure of higher education by the two methods can be represented in simplified terms by the following graph:[2]



2. Distance education is a more convenient way of learning. Students can study at times and places which best suit them.

3. The need for continuing education throughout life means that for many people, study and work must run in parallel.

4. New technology enables most - but not all - of the functions of face-to-face tuition to be done just as well - and often better - at a distance.

5. New technology will make it relatively easy for individual teachers to design and present distance teaching in a personal

and direct manner.

distance education, particularly for full-time undergraduate students, with no previous experience of studying at a higher education level, will not replace altogether the need for campus-based activities. The social role of universities for the 18 - 21 age-range will still remain important, as will the need to provide research facilities. However, even for these people, one can foresee a mixture of distance and campus-based activities.

HOW WILL NEW COMMUNICATIONS TECHNOLOGIES HELP?

I could give many examples of how different technologies can help facilitate the trend to distance education or to the achievement of the four aims outlined earlier,[3] but I will choose just four examples from technology that is already available today:

1. Computer conferencing. Using a cheap home micro-computer and a word-processing package costing around £50, a student can type up essays or leave messages or queries for the tutor. The information can be batched and sent down the telephone line in a burst (to save line costs) to be dumped on a main-frame computer. The tutor can call up all the essays one by one from the mainframe on his own micro, mark them and add comments or further work, and using a secure code-word, enter the grades against the students' files. If the tutor wishes, all students can access each other's essays and comments. Students can comment back to the tutor, or with each other, either before or after preparing their assignment. "Conversations" via the key-board can be had in real time via the computer, or messages or queries left by students or tutors to be "collected" when convenient. No computer skills are required - just a list of codes to identify students and tutors, and commands to choose functions. The software which provides this facility can be bought "off-the-shelf" for £6000, and can handle up to 200 simultaneous connections, dependent on the main-frame capabilities.

2. Cable television[4] and video-cassettes.[5] There are several important features of cable TV and video-cassettes which distinguish them from broadcasting and which hold promise for higher education:

i. Cable TV is local. Teaching materials can be delivered off-campus to students within reasonable travelling distance to the institution, thus combining the flexibility

of home or work-based study with less frequent but perhaps essential visits to the campus.

ii. Cable distribution will stimulate increased recruitment to the institution's courses

iii. The rapidly growing home ownership of video-cassette recorders means that the disadvantages of broadcasts - their ephemerality, their lack of integrated study activities, the need to be in a fixed place at a fixed time - can be avoided.

iv. Video can provide unique learning resources in the students' homes not easily available even on campus: rare experiments, field visits, case-studies, manufacturing processes, etc.

v. Production costs can be far less for cable TV or video than for broadcast production, particularly if production facilities already exist on campus.

vi. Materials can be shared - or co-produced - between different institutions, and distributed between cable systems via satellite links, on a European or even world-wide basis.

The extent to which cable will be helpful will vary from country to country, as will video-cassettes, because of different rates of growth in domestic availability, but between them, cable and video-cassette distribution allow for very low cost distribution of educational materials.

3. Computer-based audio-graphic systems. Soon it will be possible to use standard, low-cost micro-computers to design teaching materials which combine graphics with the teacher's voice, without requiring any computer programming skills. A prototype of this kind of system has already been in use at the Open University for over three years. It will eventually consist of a standard micro-computer, a stereo-cassette recorder, a light-pen, and a software package in the form of a chip. This will enable a teacher to draw diagrams in colour on the TV screen, using the light pen, type up and move words using the micro keyboard, edit frames via the computer using a menu of commands, and provide his or her own commentary synchronised with the graphics via the stereo cassette recorder. The video pictures are converted into sound signals by the micro-computer,

and can then be stored on the second track of the audio-cassette, for use in an independent learning mode. Alternatively, the system can be used in real time for distance tutoring. Because the video pictures have been converted to sound signals, these can be sent down a standard telephone line and decoded back into graphics on a TV screen at the other end. Using standard telephone conferencing facilities, and two lines, one for sound and one for the graphics, a teacher can run a tutorial with up to six distant students. Each student and teacher can see or alter what is on the screen and hear each other. The Open University version of this system, called CYCLOPS, has been running successfully in the distance teaching mode in 18 centres for three years,[6] and the independent study mode has also been successfully piloted in schools.[7] It is not clear exactly what system will become common, but the key point is that teachers can create their own audio-visual materials, using their natural (rather t than synthesised) voice, without the need for computer programming skills (although some practice and training is desirable).

4. Inter-Active Video-Discs. Computer-controlled video-discs allow for a combination of computer-assisted learning with full visual representation of 57000 still frames, 35 minutes of continuous video, or a combination of stills and movement. We are still learning about the teaching potential of this technology, but already it is clear that it enables individual students to learn complex and high-level skills - including the development of expert procedures - independently. However, it will be a considerable time before video-discs are in widespread use in homes, and there appears to be high development costs associated with the production of interactive videodisc material. In this case, considerable computer expertise and high-quality television technical standards are required.[8]

INTEGRATION WITH OTHER MEDIA

I have described four high-tech systems. However, the most important teaching innovation at the Open University has been the audio-cassette. This year over 500,000 cassettes are being sent to OU students. Cassettes are not used to deliver lectures, but in combination with printed material to talk through diagrams, tables or problems, or for analysis of meetings, classroom interaction or complex arguments. Academics find it easy to design integrated audio-print materials, and students like this form of learning, which allows them to carry out activities and get feed-back. Onehour of audio-cassette material,

equivalent to three hours of study with print accompaniment can be delivered to students for a cost of 50 pence.

Some of you may be surprised that in my list of high-tech developments, I did not list computer-assisted learning. This will become increasingly important, but it will not be the panacea some people seem to expect. At the moment, the range of teaching functions for which CAL is appropriate is limited, and while this will increase with the development of courseware based on principles derived from artificial intelligence, there are some inherent problems which are likely to limit its applications. The main problem is the need to work through some form of authoring language which can convert what the teacher wants to do into terms suitable for the computer. However sophisticated the programme, there will inevitably be restrictions on what the teacher and student can do. Furthermore, the cost of CAL courseware development remains high - about 100 hours of development time for every hour of student use. While these costs should come down with more sophisticated authoring languages making it easier for teachers to write materials for CAL, this technology seems to lack the flexibility of some of the other systems. The power and flexibility of the (natural) human voice and the richness of video's presentational form both highlight some of the inherent limitations of CAL. That is why I believe the communications capacity of micro-processor technology to be the really significant development.

The power of audio-cassettes and the limitations of CAL both underline the fact that there is no single 'super-medium' that can handle all the range of teaching tasks. A multi-media approach is essential in distance education at least, and probably in campus-based education also. Indeed, it always has been, since the invention of the printing press. The significant point today is that the range of media now available has suddenly increased, making the choice of media and the identification of the different tasks that are best done by different media an essential pedagogical task.

Thus I see the role of the instructional designer who is familiar with the strengths and weaknesses of a wide range of media and who can advise and help train subject specialists in using media becoming crucial. There are arguments about the ways in which such advice and training should be provided, but the recent tendency in British higher education establishments of closing down educational technology centres when faced with financial cuts is clearly a move in the wrong direction.

TWO MODELS OF DISTANCE EDUCATION

A major obstacle to the development of distance education has been the need to set up large specialist institutions with high starting costs, such as the British or Dutch Open Universities and Fernuniversitat. However, the new technological developments I have outlined, and in particular the communications possibilities of computer technology, now offer the possibility of an alternative model to the large, centralised specialist system, requiring sophisticated learning packages designed by large course teams.

New communications technology, with its easy access and "transparency" in its ease of use by teachers, allows for the development of low-cost, local, tutor-controlled systems of distance education. This will enable existing conventional education institutions to expand into off-campus teaching at relatively low cost, using either on-campus staff, or more interestingly, specialists from industry or the public sector. The role of the institution would therefore be to provide a communications system allowing for a combination of off-campus and on-campus teaching, into which students, other agencies involved with education and training, and on-campus staff can plug.

ESSENTIAL CONDITIONS: THE INSTITUTION AS A BARRIER TO INNOVATION

It is important to understand that the technology is not the problem. The technology needed to achieve the four aims outlined at the beginning is here now, and will get increasingly easier to use. The main barrier is the inability of large institutions to carry through the fundamental changes in organisation, financial arrangements and teaching strategies that are essential if flexible off-campus teaching is to be achieved. A coherent financial system which accepts off-campus teaching as an essential cost, and the ability to wire costs between these sectors is a prerequesite. There is a need for a major training programme on the selection and use of new communications technologies for existing academic and administrative staff, who also need to understand these technologies. This does not mean courses in computer programming but on the functions of the various technologies, their costs, and organisational requirements. There is a need to protect and expand instructional design services within institutions, and finally a need to integrate administrative and teaching computing systems, so that all the communications regarding fees, enrolment, examinations, and teaching can be handled by the same system.

The major problem is that all this has to be done during a period when there will be less money available than at present. This means then changing priorities and current, frankly inefficient on-campus teaching practices, to release reources for new developments, and much greater use of "off-the shelf" software and courseware. If all this seems impossible, it is salutary to remember that the world's second largest computer company receives 40% of its income in the U.S.A. from sales to education. Universities in particular have strong leverage here, if they can only organise themselves.

The potential then is limitless. What is required is the will and determination to change.

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